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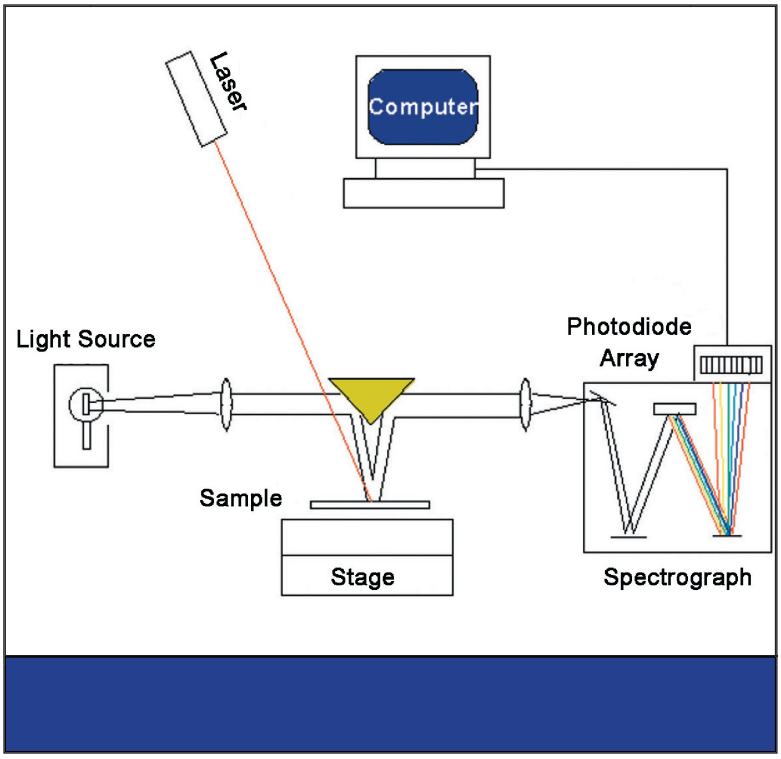
Science and Technology for Tomorrow's Aerospace Forces

Success Story

MEASURING DEVICE FOR THIN SEMICONDUCTOR FILM DEPOSITED ON SEMICONDUCTOR WAFERS



Scientists can now accurately measure the thickness, composition, and doping of epitaxial layers by using reflected white light off the surface of a semiconductor wafer. Epitaxy refers to the growing of crystals of one mineral on the face of another mineral so both substrates have the same structural orientation. This nondestructive measurement system will permit rapid development of new device structures at lower cost and with increased yield, while providing a quality assurance tool for semiconductor device manufacturers.

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Achievement

Scientists at the Sensors Directorate developed and patented an innovative technique that measures thickness, composition, and doping of semiconductor epitaxial layers. Users accomplish this by measuring and fitting the spectroreflectance in wavelength range where there is significant variation of the refractive index (near the semiconductor band gap). Manufacturers formerly spent hours taking measurements nondestructively, but now spend just seconds.

Background

Manufacturers have used spectroreflectance since the 1960s to measure the thickness of semiconductor layers. While this method is very successful in measuring thickness, scientists must use another technique to measure material composition.

Extracting composition and thickness using spectroreflectance is difficult due to a coupling problem. In spectroreflectance, the optical thickness, which is proportional to n x d where n is the composition-dependent refractive index and d is the actual layer thickness, is actually measured.

The same optical thickness can result by increasing composition and decreasing thickness or vice versa--a condition known as coupling. The coupling problem occurs in the wavelength range in which users measure the reflectance because the refractive index is substantially constant as a function of wavelength. As a result, manufacturers analyzed the composition using other measurement techniques as the traditional approach to decouple the composition and thickness.

Directorate researchers overcame this coupling problem by measuring the spectroreflectance in a wavelength range where there are significant variations of the refractive index, near one of the semiconductor critical points. They obtained good agreement between the composition determined by spectroreflectance and other common measuring techniques. This technique received a US patent.

Sensors
Emerging Technologies

Additional information

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